

body, whose duty it should be to receive, consider, and decide on questions of proposed changes. The *Nautical Almanac* comes in contact with such large classes of men scattered over the world, that it is hardly possible that the experience of one or two officials in London can meet all the wants of those using it. It is no reflection, then, on those who have had the guidance of our ephemeris that they have not succeeded perfectly in an impossible task; indeed, that after some sixty years of uncontrolled management, the *Nautical Almanac* is so little behind the times is the best testimony to the care which has been given to it. But we should not be content with this. A Nation whose ships are in every Sea, and whose Colonies surround the globe, should not be content to lag behind, but should be amongst the leaders in giving facilities for its widely-scattered astronomers, mariners, and geographers.

P.S.—The Astronomer Royal has stated that Hansen's Tables include empirical terms, and I believe that some of his coefficients have been determined so as to make the Tables agree with observation; theory, however, prescribed the arguments and the numbers are Hansen's. Two of Newcomb's corrections are purely empirical and have no foundation in theory, and the other three, which I have proposed to print in the Ephemeris, arise from changes made in Hansen's data; they may be improvements, but they cannot be considered part of Hansen's Tables.

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*Note on the Apparent Star Places of the Nautical Almanac.*

By H. H. Turner, M.A., B.Sc.

In the course of the longitude operations recently undertaken at the Royal Observatory, Greenwich, occasion arose for comparing the places of the circumpolar stars given in the *Nautical Almanac* with those of other almanacs, viz. the *Connaissance des Temps*, the *Berliner Jahrbuch*, and the *American Ephemeris*, which will hereafter be designated *C.T.*, *B.J.*, and *A.E.* respectively. The meridians being different, simple interpolation must be used for such comparisons, except in the case of the *N.A.* and *C.T.*, where the difference of meridians is so small as to render this unnecessary.

The apparent places may be regarded as the sum of two terms: (1) the adopted mean place, and (2) the star correction. The first depends on previous observations generally selected from national sources, and is therefore different in different almanacs; but the second is a mere matter of computation, the elements for which are known with such accuracy that the results might be expected to agree very closely.

The original comparison referred to the years 1889 and 1890, and it was found that for these years the star corrections for

*Polaris* of the *N.A.* and *C.T.* did not show a satisfactory agreement. The *N.A.* was then compared with other ephemerides, and other years were examined, and the following notes of the results may be of interest.

Previous to 1875 the "terms depending on  $2D$ ," as they are generally called, were not incorporated in the printed star places of the *N.A.*, but a separate table was given to facilitate the application of these terms for the five circumpolars. The comparison with other almanacs for circumpolar places thus involves some labour, and it will be convenient to begin with the year 1875. From 1875 to 1887 the agreement between the places of the *N.A.* and the *C.T.* is quite satisfactory, the differences for right ascension of *Polaris* ranging over about  $0^s.10$  throughout the year. A curious exception must be made of the first year (1875) itself, when these differences are so accurately constant as to make anyone who has had experience of independent computation somewhat suspicious. It may be remarked that the *N.A.* for 1875 was published in 1871, and the *C.T.* in 1873.

For these years then we may bracket the two almanacs together; and the remark made by Professor Auwers in the *B.J.* for 1884, Appendix, p. 92, will probably apply to the whole period 1875–1887. After stating that the *B.J.* and *A.E.* agree sensibly from the year 1883 onwards, he proceeds:—"The *N.A.* and the *C.T.* agree in their reductions. Both set down the principal lunar term in the formula, but neglect it in the computed values of  $A, B, C, D$ , and in the 10-daily ephemerides (for non-polar stars); but, besides this, they quite unnecessarily neglect sensible terms of long period, thus introducing errors amounting to  $0''.25$ . Without considering terms which up to  $70^\circ$  declination do not singly reach  $0''.002$ , the following corrections are thus applicable to the reductions from mean to apparent place as given in the *C.T.* and *N.A.* :—

$$\begin{aligned}\Delta(\Delta\alpha) &= +0''.135 \sin(\odot + 82^\circ.2) - 0''.003 \sin 2\odot - 0''.046 \sin \delta, \\ &\quad + 0''.059 \sin(\odot + 82^\circ.2) \sin \alpha \tan \delta, \\ &\quad - 0''.009 \cos(\odot + 280^\circ.9) \cos \alpha \tan \delta. \\ \Delta(\Delta\delta) &= +0''.059 \sin(\odot + 82^\circ.2) \cos \alpha + 0''.009 \cos(\odot + 280^\circ.9) \sin \alpha.\end{aligned}$$

It does not appear that any notice has been taken of this remark in these almanacs to the present time, so that computations based on these ephemerides require the corresponding small corrections—for instance, the places of the Greenwich Ten-Year Catalogue (1877–1886).

But there remains a curious discrepancy. From the year 1888 the agreement between the *N.A.* and *C.T.* for right ascensions of close circumpolars exists no longer, the range of difference for *Polaris* being more than  $0^s.50$ . The *N.P.D.s* are apparently unaffected.

The following table exhibits the range of discordance in apparent places of *Polaris* between the *N.A.* and *C.T.* for various years :—

Year.	Range in R.A.	Range in N.P.D.
	<sup>s</sup>	<sup>"</sup>
1875	0.00	0.0
1880	0.09	0.3
1883	0.19	0.3
1886	0.18	0.4
1887	0.18	0.3
1888	0.57	0.2
1891	0.46	0.2

Concerning the reason for this discrepancy M. Lœwy kindly informs me that from 1888 the formulæ of Fabritius have been used in obtaining apparent places for the *C.T.*, and this change would appear to be an advantage on comparing the *C.T.* and *N.A.* respectively with other ephemerides. The following table shows the range of the differences in the apparent R.A.'s of the four circumpolars for the year 1890 :—

			<i>B.J.-N.A.</i>	<i>B.J.-C.T.</i>
			<sup>s</sup>	<sup>s</sup>
<i>Polaris</i> ...	...	...	0.45	0.12
<i>Cephei</i> 51 ...	...	...	0.29	0.04
$\delta$ <i>Ursæ Minoris</i> ...	...	...	0.21	0.04
$\lambda$ <i>Ursæ Minoris</i> ...	...	...	0.86	0.13

With regard to the N.P.D.s it may be questioned whether computation to one place of decimals is quite enough. It is apparently to this that we may trace the discordances ranging one or two tenths on either side of zero, which thus become sensible. The range corresponding to 0".3 in right ascension of *Polaris* would be  $0^s.3 \div 15 \sin N.P.D. = 0^s.9$ , about which some care is taken in computation. There appears to be no reason for withholding the same care from N.P.D. computations; and this remark would apply to all stars.

*Photograph of Stars in the region of Tycho's Nova.*

By Isaac Roberts.

The photograph which accompanies this communication was taken on January 12, 1890, with an exposure of the plate during 2 hours and 55 minutes. The right ascension at the middle of the plate is about 0<sup>h</sup> 16<sup>m</sup>, and the declination north 63° 18'. Four pencil lines, enclosing a rectangular space, are drawn on the photograph, so as to correspond with the chart of this region made by D'Arrest in 1864, and the position of the *Nova*, as given by him, is shown marked by a white circle.